

Impact of Bio-fertilizer with NP Application on yield and yield components of wheat variety Tijaban-10

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Abstract— It was noted from the present study that the maximum grain yield and fresh biomass yield 2799 kg ha⁻¹ and 10373 kg ha⁻¹ respectively was recorded in treatment-3 with application of Bio-fertilizer (*Azospirillum*A1-Q) + N 45kg ha⁻¹ and P₂O₅ 30kg ha⁻¹. Whereas, minimum grain yield and fresh biomass yield 1340 Kg ha⁻¹ and 6783 kg ha⁻¹ respectively was noted in treatment-1 (control). Both grain and biomass yield increased due to increase in number of tillers, grain weight and suitable Nitrogen fixation, showing positive effect of mineral fertilizer (Biomass yield= Clipping of crop before heading stage for fodder purposes). The results proved that application of bio fertilizer in combination with N 45 kg ha⁻¹ and P₂O₅ 30 kg ha⁻¹ increased 100% grain yield and 52% fresh biomass yield as compared to the treatment-1 (control).

Keywords— Wheat, Bio-fertilizer, nitrogen, phosphorous, yield components.

I. INTRODUCTION

Bio fertilizer is defined as a substance which contains living organisms when applied to seed, plant surface or soil, colonize the rhizosphere or the interior of plant and promotes growth by increasing supply or availability of primary nutrients to the host plant (Vessey, 2003). Bio-fertilizers are well recognized as an important component of integrated plant nutrient management for sustainable agriculture and hold a great promise to improve crop yield (Narula et al., 2005). Microbial inoculants or bio fertilizer is an important component of organic farming which helps the crops through required nutrients. These microbes help to fix atmospheric nitrogen, soluble and mobilize phosphorous, translocate minor elements like zinc, copper to the plants, produce plant growth promoting hormones, vitamins, amino acid and control plant pathogenic fungi. It improves the soil health and increase crop production. Bio-fertilizer like *rhizobium*, *azotobacter*, *azospirillum* and blue green algae are in use since long. *Azospirillum* inoculants are recommended mainly for wheat, sorghum, millets, maize, sugar cane and vegetable crops. Plant growth promoting *rhizobacteria* are free living microorganisms having beneficial effects on plants by colonizing their roots. They include such effects as the production of phytohormones, auxin, cytokines and gibberellins (Garcia, 2001) and enhanced the release of the nutrients to plants Balochistan Agricultural Research & Development Centre western bypass Brewery Quetta, Pakistan (Nautical et al., 2000). The microorganisms involved in P volatilization can enhance plant growth by increasing the efficiency of biological nitrogen fixation, enhancing the availability of other trace elements and by production of plants growth promoting substances (Gyaneshwari et al., 2002). *Azotobacter* and *azospirillum* significantly increased wheat and barley yield in irrigated land as well as in rain fed. Although, the inoculation treatment increased irrigated wheat yield on an average by 24%, the obtained difference depends on the farmers' location with increasing environmental index (Pauwet et al., 2008). In 2005 -06 the Biofertilizer treatment increased irrigated grain yields by 11% in Honam, while the yield of rain fed barley increased by 36%. In the follow year, grain yield of irrigated wheat increased by 24%. These differences in response are suggested to be an effect of the fertility level of the soil and the fertilizer application. Wheat and in particular irrigated wheat, is grown on the most fertile soil and receives the highest amount of mineral fertilizers. On the contrary, rain fed barley is grown on the most marginal soil with low inherent fertility and no mineral fertilizer. This is supported by other researches (Ali et al., 2005). After the introduction of chemical fertilizers in the last century, farmers were happy of getting increased yield in agriculture in the beginning. But slowly chemical fertilizers started displaying their ill- effects such as leaching out and polluting water basins, destroying micro-organisms and friendly insects, making the crop more susceptible to the attack of diseases, reducing the soil fertility and thus causing irreparable damage to the overall system (Wu et al., 2005). The aim of the present study was to determine the impact of bio fertilizer with NP application on yield and yield components of wheat variety 'Tijaban-10 in agro climatic zone of Quetta Balochistan.

II. MATERIALS AND METHODS

Study was carried out at Arid Zone Research Centre Quetta, Balochistan, under irrigated conditions during rabbi season 2009-2010. The location falls in cold highlands with minimum temperature up to -12°C or below. Each treatment was replicated three times in randomized complete block design. The plot size was $9\text{m} \times 10\text{m} = 90\text{m}^2$ in each treatment. Row to row distance was 25cm. An improved wheat variety "Tijaban-10" was used as test crop. Seed was applied @ 125Kg ha^{-1} . The land was thoroughly prepared and seeds were treated with calculated quantities of bio fertilizer. Bio fertilizer (A1-Q) *azotobacter* and *azospirillum* was provided by national agricultural research centre, Islamabad. Three treatments including treatment:1 un inoculated as well as un fertilized, treatment:2 N 90kg ha^{-1} and P_2O_5 60kg ha^{-1} , treatment:3 bio fertilizer + N 45kg ha^{-1} and P_2O_5 30kg ha^{-1} (Urea and TSP form) were kept. Yield components were recorded on plant height (cm), (Fresh Biomass yield kg ha^{-1} =Clipping of crop before heading stage for fodder purposes), (number of tillers/ m^2 , total dry matter kg ha^{-1} , 1000 grain weight (g) and grain yield kg ha^{-1} . All the observations were analyzed by using the Fisher's analysis of variance techniques and difference among treatments means were compared by using the LSD test at $p < 0.05$ (Steel *et al.*, 1997).

III. RESULTS AND DISCUSSION

The data presented in Table-1 reveals that bio fertilizer application on plant height was significant. Maximum plant height (68 cm) was observed in treatment-3 bio fertilizer + N 45kg ha^{-1} and P_2O_5 30kg ha^{-1} while the minimum plant height (49 cm) was recorded in treatment-1 (Control). The same type of study was carried out by (Mohammad 2002). He reported that a treatment receiving P+ *Azotobacter* improved plant height, number of tillers and spikes per plant and significantly increased grain, shoot and biomass yield of a wheat crop. Such increase in plant height may be occurred due to the stimulation of cell division and internodes elongation resulted from nitrogen application (Sabah *et al.*, 2006). It is also evident from (Table -1) that effect of bio fertilizer application on biomass yield kg ha^{-1} was significant. Maximum biomass yield (10373kg ha^{-1}) was recorded in treatment-3 bio fertilizer + N 45kg ha^{-1} and P_2O_5 30kg ha^{-1} while minimum biomass yield (6783kg ha^{-1}) was recorded in the treatment-1 (Control). These results are consistent with the findings of (Plensicar&Kustori 2005) who reported that maximum biological yield was found at higher planting density. Good soil fertility management ensures adequate nutrient availability to plants and increases yields. High above-ground biomass yield is obviously accompanied by an active root system, which releases an array of organic compounds into the rhizosphere (Mandal *et al.*, 2007). Positive effect of bacteria in providing nitrogen causes to increase cell division in plant and distance between nodes in stem and finally plant length. (Sharifi and Haghniya, 2007) reported increased biomass and vegetative growth with use of nitroxin biological fertilizer. In a study on the effect of *azotobacter* and *azospirillum* + chemical fertilizer on biological yield in wheat, (Hajibolanet *et al.*, 2005) reported that this treatment significantly increased biological yield as compared with control. (Rajaeiet *al* 2008) concluded that *Azotobacter* not only affected the increase in growth and chlorophyll content of wheat, but also had a positive effect on uptake and transfer of elements and consequently, caused the increase in biological yield.

Table-1 showed that effect of bio fertilizer application on plant density was significant. Maximum plant density (195) was recorded in treatment-3 bio fertilizer + N 45kg ha^{-1} and P_2O_5 30kg ha^{-1} while minimum plant density (150) was recorded in treatment-1 (Control). Several other studies reported that plant population is a key factor for attaining maximum grain yield (Akbar *et al.*, 2002).

It is obvious from the data (Table- 1) that the bio fertilizer application on spike length was not significant. Maximum spike length (13cm) was recorded in treatment-3 bio fertilizer + N 45kg ha^{-1} and P_2O_5 30kg ha^{-1} and minimum spike length (11 cm) was recorded from the treatment-1(control). Highest plant population had a negative impact on ear length. They observed that ear length decreased with increase in plant population. Ear length was more in planting density when compared with other treatments. This may be due to the fact that available nutrients, moisture, space and light become limited in high plant population due to high competition of soil resources between plants. Ultimately plants produced relatively small ears reported by (Hassan 2000).

It is apparent from (Table-1) that bio fertilizer application on number of tillers/ m^2 was significant. The maximum (491) numbers of tillers/ m^2 were observed in treatment-3 bio fertilizer + N 45kg ha^{-1} and P_2O_5 30kg ha^{-1} while the minimum (307) number of tillers/ m^2 were recorded in treatment-1 (control). Same type of study was also carried out by (Mohammad, 2002). He reported that the effect of treatment receiving P + *azotobacter* in improving number of tillers increased significantly the grain, shoots and biomass yield of wheat crop.

The presented in (Table-1) showed that use of bio fertilizer application on dry matter yield kg ha^{-1} was significant. Maximum dry matter yield (8750 kg ha^{-1}) was observed in treatment-3 bio fertilizer + N 45 kg ha^{-1} and P_2O_5 30 kg ha^{-1} while the minimum dry matter yield (4900 kg ha^{-1}) was recorded from the treatment-1 (control). With respect to response of yield and its components to bio fertilizer, table-1 showed that bio fertilization either with *azotobacter* or yeast single or combined had a significant positive effect on grain and straw yields. This increment of yield and its components may be due to the positive effect of bio fertilization which play important role in assimilation processes of wheat plants which reflected on enhancing these characters (Mahdi *et al.*, 2010). (Idris *et al.*, 2001) reported increase in dry matter yield with the integration of organic manure with mineral fertilizer. These results are in agreement with (Singh, Agarwal, Zeidan and Kramany 2001), and similar results were obtained by (Shaaban, 2006) who reported that higher grain yield were recorded with (80kg organic (chicken) N+40kg inorganic N).

The data also reveals (Table-1) that the results of bio fertilizer application on grain yield kg ha^{-1} was significant. The maximum grain yield (2799 kg ha^{-1}) was observed in treatment-3 bio fertilizer + N 45 kg ha^{-1} and P_2O_5 30 kg ha^{-1} while minimum grain yield (1340 kg ha^{-1}) was recorded from the treatment-1 (Control). Keeping all these facts in view, phosphorus and *azotobacterization* applied alone and in combination with on the yield, yield components and nitrogen and phosphorus uptake by wheat (*Triticum aestivum*), had a beneficial effect in wheat production. Phosphorus alone and in combinations with inoculations and dual inoculation all significantly increased the grain yield over control as well as single inoculations. These results confirmed the previous findings. (Biswas *et al.*, 2000; Ragaeiet *al.*, 2008; and Hajibolanet *al.* 2005) reported that treatment of *azotobacter* and *azospirillum* + chemical fertilizer significantly increased grain yield as compared with control (chemical fertilizer). They stated that nitrogenous compounds, that are built up following the interaction between root and *azotobacter*, might be transferred more quickly and efficiently (e.g. at loading stage) to shoots than normal nitrogen transfer (in un-inoculated plants).

The data presented in (Table -1) indicated that efficiency of bio fertilizer application on 1000 grain weight (g) was significant. The maximum 1000 grain weight (34.0 grams) was recorded from the treatment-3 bio fertilizer + N 45 kg ha^{-1} and P_2O_5 30 kg ha^{-1} which showed positive effect of grain weight on total grain yield kg ha^{-1} while minimum 1000 grain weight (30.5 grams) was recorded from the treatment-1 (control) which reveals decreased yield. (Ragaeiet *al.*, 2008) reported that inoculation of wheat with *azotobacter* significantly increased grain number per spike and 1000 grain weight as compared with control (no-fertilization). Similar results have also been reported by (Zeidan and Kramany 2001) who observed higher 1000 grain weight with the use of organic manure and mineral nitrogen. The large accumulation of proteins and other reserved food in the seed due to which 1000 grain weight was increased may be due to the ease availability of nitrogen and other soil nutrients from fertilizers.

The data in (table -1) reveals that the results of bio fertilizer application on harvest index % were not significant. The maximum harvest index (32.0 %) was observed in treatment-3 bio fertilizer + N 45 kg ha^{-1} and P_2O_5 30 kg ha^{-1} while minimum harvest index (27.0%) was recorded in treatment-1 (Control) respectively. The non-significant differences in Harvest Index may relate to instability of Harvest Index due to different environments, positive effect of biofertilizer may resulted from its ability to increase the availability of Phosphorus and other nutrients especially under the specialty of the calcareous nature of the soil of the region which cause decreasing on the nutrients availability, results agree with (Afzal *et al.*, 2005)

TABLE 1
SOME MORPHOLOGICAL CHARACTERS OF WHEAT VARIETY TIJABAN-10 USED FOR STUDY

Treatments	Plant height (cm)	Biomass Yield kg ha^{-1}	Plant density	Spike length (cm)	Number of tillers/ m^2	TDM kg-ha^{-1}	Grain yield kg ha^{-1}	1000 grain wt: (g)	H.I
T1	49 b	6783 b	150b	11	307b	4900 b	1340 b	30.5 b	27.0
T2	62 a	10057 a	180a	12	401a	6590 a	2070 ab	33.0 a	31.0
T3	68 a*	10373 a*	195a*	13 ns	491a*	8750 a*	2799 a*	34.0 a*	32.0 ns

Values followed by different letters within same column are significant at $\alpha=0.050$

T1-Control

T2- Nitrogen applied @ 90 kg ha^{-1} + Phosphorous 60 kg ha^{-1}

T3- Bio-fertilizer applied@ $1/2 \text{ kg}/60 \text{ kg seed}$ + Nitrogen 45 kg ha^{-1} + Phosphorous 30 kg/ha^{-1}

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